

Aha Huliko'a Workshop Series

Peter Muller
University of Hawaii
Department of Oceanography
1000 Pope Road, MSB 429
Honolulu, HI 96822
phone: (808)956-8081 fax: (808)956-9164 email: pmuller@hawaii.edu

Grant Number: N00014-00-1-0168
<http://www.soest.hawaii.edu/PubServices/AhaHulikoa.html>

LONG-TERM GOALS

The goal of the workshop series is to review the state-of-the-art, to identify areas of ignorance, and to make recommendations for future research on a topic or topics relevant to the Office of Naval Research.

OBJECTIVES

The subject of the 2007 workshop was “*Extreme Events*.” The participants were tasked to review observations of extreme events, identify the physical processes that lead to them, and assess their probability and predictability.

APPROACH

Conduction of workshop and publication of workshop proceedings and a meeting report in a professional journal.

WORK COMPLETED

A four-day workshop on “*Extreme Events*” was held from January 23th through 26th, 2007, in Honolulu, Hawaii. The workshop brought together about twenty five researchers from the fields of oceanography, meteorology and statistics. It was convened by the PI and Chris Garrett.

RESULTS

Extreme events are characterized by adjectives such as rare, exceptional, surprising, unexpected and catastrophic, and are often defined as “rare but influential” or “events on the tail of a probability distribution”. Extreme events occur in natural, technical and societal environments, and their description, understanding and prediction are of great importance. Extreme events may be studied as a statistical problem (with emphasis on their frequency of occurrence as a function of magnitude) or as a dynamical problem (with emphasis on the underlying mechanisms). The workshop brought together researchers from the fields of oceanography, meteorology and statistics to assess whether benefit can

Report Documentation Page

*Form Approved
OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 2009	2. REPORT TYPE	3. DATES COVERED 00-00-2009 to 00-00-2009		
4. TITLE AND SUBTITLE Aha Huliko'a Workshop Series			5a. CONTRACT NUMBER	
			5b. GRANT NUMBER	
			5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)			5d. PROJECT NUMBER	
			5e. TASK NUMBER	
			5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University of Hawai'i, Department of Oceanography, 1000 Pope Road, MSB 429, Honolulu, HI, 96822			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited				
13. SUPPLEMENTARY NOTES				
14. ABSTRACT				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified		
18. NUMBER OF PAGES 3	19a. NAME OF RESPONSIBLE PERSON			

be obtained from combining the statistical and dynamical approaches in order to answer important questions such as:

- Do extreme events have special physics that occurs rarely in space and time?
- Are there “dynamical ceilings” that limit the magnitude of extreme events and prevent the reliable extrapolation of statistical results?
- To what extent and how far in advance can extreme events be predicted, either deterministically or statistically?
- When can we say with confidence that an increase in the occurrence or magnitude of extreme events is due to a shift in the underlying system rather than a statistical fluctuation?

The workshop addressed these and other questions, using examples from oceanographic and meteorological phenomena (such as hurricanes, waves, turbulence, rain fall, sea level, and storms). Some main results are:

- Extreme events can have different physics from normal events, though definitive examples of this, such as hurricanes, are rare.
- Dynamical ceilings that would invalidate simple extrapolation of statistical distributions can occur, but the ceilings are often too high to be particularly useful.
- The deterministic prediction of extreme events with a useful lead time is very dependent on the process. Statistical prediction, in the sense of a knowledge of the likely return period of a particular event, can be enhanced by recognition that events can arrive in clusters if there is a connection, either multiplicative or simply additive, between low and high frequency parts of the signal.
- Statements about the increased incidence of extreme events due to a shift in the underlying regime can only be probabilistic and are best treated within the framework of Bayesian statistics, which allows in a well-defined way for differing prior expectations.

IMPACT/APPLICATIONS

Review of the state-of-the-art of extreme event research, identification of major open problems and recommendations for future research.

RELATED PROJECTS

None

PUBLICATIONS

Garrett, C. and P. Müller, 2008: Extreme events. *BAMS*, **89**, 1733.

Garrett, C. and P. Müller, 2008: Supplement to Extreme Events. *BAMS*, **89**, ES45-ES56
(<http://dx.doi.org/10.1175/2008BAMS2566.2>)

Müller, P., C. Garrett and D. Henderson, 2007: "Extreme events." Proceedings, 'Aha Huliko'a Hawaiian Winter Workshop, School of Ocean and Earth Science and Technology, Special Publication, 172pp.